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Clausocaris pinnai n. sp., (Order Clausocarida nov.), thylacocephalan crustacean from the Norian of the Preone Valley (Udine, N. Italy) and morphological considerations on Thylacocephala

Abstract – The present work deals with *Clausocaris pinnai,* new species of thylacocephalan crustacean from the Norian Formation "Dolomia di Forni" in the Preone Valley (Udine, N. Italy); *Clausocaris* is attributed to new Order Clausocarida. There follows a discussion about some interpretations on the structures and the behaviour of Thylacocephala found in the German Jurassic.

Riassunto – *Clausocaris pinnai* n. sp. (Ordine Clausocarida nov.), crostaceo tilacocefalo del Norico della Val Preone (Udine, N. Italia) e considerazioni morfologiche sui Thylacocephala. Viene descritto *Clausocaris pinnai,* nuova specie di crostaceo tilacocefalo attribuito al nuovo ordine Clausocarida, rinvenuto nella "Dolomia di Forni" (Norico) affiorante in Val Preone (Udine). Vengono anche discusse alcune interpretazioni sulle strutture ed il modo di vita dei tilacocefali rinvenuti nel Giurassico tedesco.

Key words: Crustacea, Thylacocephala, Clausocarida, Trias, Norian, Carnic Prealps.

Introduction

Visiting the small palaeontologic museum of Mr. Romano Binutti in Attimis (Udine, N.E. Italy), I was able to examine some fossil remains from the Norian of Val Preone. Such fossils can be ascribed to a new systematic

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entity of thylacocephalan crustaceans. The area where such material was found is the same where some thylacocephala of genera *Microcaris* and *Atropicaris* were recovered (Dalla Vecchia & Muscio, 1990).

The Norian fossiliferous beds belong to the informal unit referred to as «Dolomia di Forni» (Mattavelli & Rizzini, 1974).

The material gathered by Mr. Binutti is not in good state of preservation; these fossils are in fact very frail and incomplete. Their morphology is quite similar to that of the specimens found in the Callovian of La Voulte-sur-Rhône in France (Secretan & Riou, 1983) and in the Tithonian of Solnhofen in Germany (Oppenheim, 1888), that were attributed to the genus *Clausocaris* (Oppenheim, 1888).

This is the first time that it has been possible to discover in Triassic strata some organisms which can be recognized as belonging to the genus *Clausocaris* owing to the morphology of the carapace and of cephalic appendages.

So far, in the Trias thylacocephalan crustaceans have been represented by the genera *Atropicaris* and *Microcaris* from the Norian, with specimens discovered in the «Calcare di Zorzino» (Pinna 1974, Arduini 1988) and in the «Dolomia di Forni» (Dalla Vecchia & Muscio, 1990), as well as by the genus *Atropicaris* found in the Rhaetic of «Argillite di Riva di Solto» (Arduini & Brasca, 1984) and by the genus *Austriocaris* of the Austrian Carnian (Glaessner, 1931). Quite recently (Arduini, 1990), some forms belonging to the genus *Ostenocaris* and to the new genus *Ankitokazocaris* have been recorded in the Scythian of Madagascar.

The differences observed between Jurassic *Clausocaris* and the specimens found in the Norian rocks make us believe that the latter represent a new specific entity.

Historical notes

The first fossils to be included into the genus *Clausocaris* were described by Oppenheim, 1888. The author made his observations on materials from the Lithographic Limestone of Solnhofen in Bavaria, which he ascribed to the genus *Clausia;* this generic name was changed into *Clausocaris* by H. Polz (1989), because *Clausia* had already been used in 1863 by Claparede, in order to describe a genus of copepod.

The systematic assignment of the genus *Clausocaris* (sub *Clausia*) varied as time went by. It was initially considered as an indeterminated larval state of stomatopods (Oppenheim, 1888) and such it was included by Holthuis & Manning (1969), although doubtfully, in the Treatise of Invertebrate Paleontology (part R, Arthropoda 4).

In 1985, while studying similar material from the Callovian of La Voulte-sur-Rhône, Secretan realized that they were not larval forms of stomatopod, but that they were instead adult organisms, which she assigned to the class Conchyliocarida instituted by herself in 1983, and now considered as an order of the class Thylacocephala (Rolfe, 1985). In that occasion, she described the species *Clausia ribeti.*

According to the first observations, the crustaceans belonging to the genus *Clausocaris* are typically characterized by a subtriangular carapace with two pairs of cephalic appendages protruding from it. The first pair is

extremely subtle and elongated and the second pair, which is very close to the cephalic margin, is shorter and stronger. Oppenheim considered these appendages respectively as the second and the first pair of maxillipeds.

The more elongated, uniramous appendages end into several thin structures that, as a whole, form a sort of small spade. Oppenheim came to conclusion that they helped these organisms to swim, and he ruled out the possibility they could have defensive or predatory functions.

In addition, he was able to observe seven, perhaps eight segments in the thoracic-abdominal section, i.e. pleopods which he considered as part of the abdomen, and he counted ten segments – the interpretation of which is uncertain – that he described as thoracic segments «suspended on the others».

A recently paper (Polz, 1990) dealing with the morphology of *Clausocaris lithographica* contains some interpretations with which I partly disagree and I shall discuss later on.

Paleontological description

Schram (1990) described some Thylacocephala from the Middle Pennsylvanian biotas of Mazon Creek; the specimens attributed to new genus *Convexicaris* have a carapace and the general aspect of the cephalic appendages very like to the specimens of the genus *Clausocaris*.

The presence of specimens similar in general morphology but stratigraphically distant, probably means that these forms belong to a phyletic stock different from the stock characterized by big cephalic appendages and subrectangular carapace.

I retain, owing to these evident morphological differences, *Convexicaris* and *Clausocaris* cannot be ascribed to the order Conchyliocarida; for these forms it is necessary therefore to establish a new order.

Order Clausocarida nov.

Diagnosis: carapace subtrapezoidal, ornamentation absent or very thin, cephalic sac large, anterior margin weakly concave, beak absent. Three pairs of long and thin cephalic appendages, of which the third pair is the most developed.

Class Thylacocephala Pinna, Arduini, Pesarini & Teruzzi, 1982

Order Clausocarida nov.

Genus *Clausocaris* (Oppenheim, 1888)

Clausocaris pinnai n. sp.

Derivatio nominis: dedicated to Professor Giovanni Pinna.

Type locality: Val Preone (Udine, Northern Italy).

Geological age: Norian (Upper Trias).

Holotype: provisional category No. (State No. pending) R.B. 1520, Collection of the Mostra del Fossile in Attimis, Udine.

Paratypes: provisional cat. No. R.B. 1546, R.B. 1548, Collection of the Mostra del Fossile in Attimis (Udine).

Diagnosis: subtrapezoidal-shaped carapace, three pairs of cephalic appendages, the first of which are elongated, subtle and pointed.

Fig. 1 — *Clausocaris pinnai,* holotype (× 2,5) photo P. Arduini.

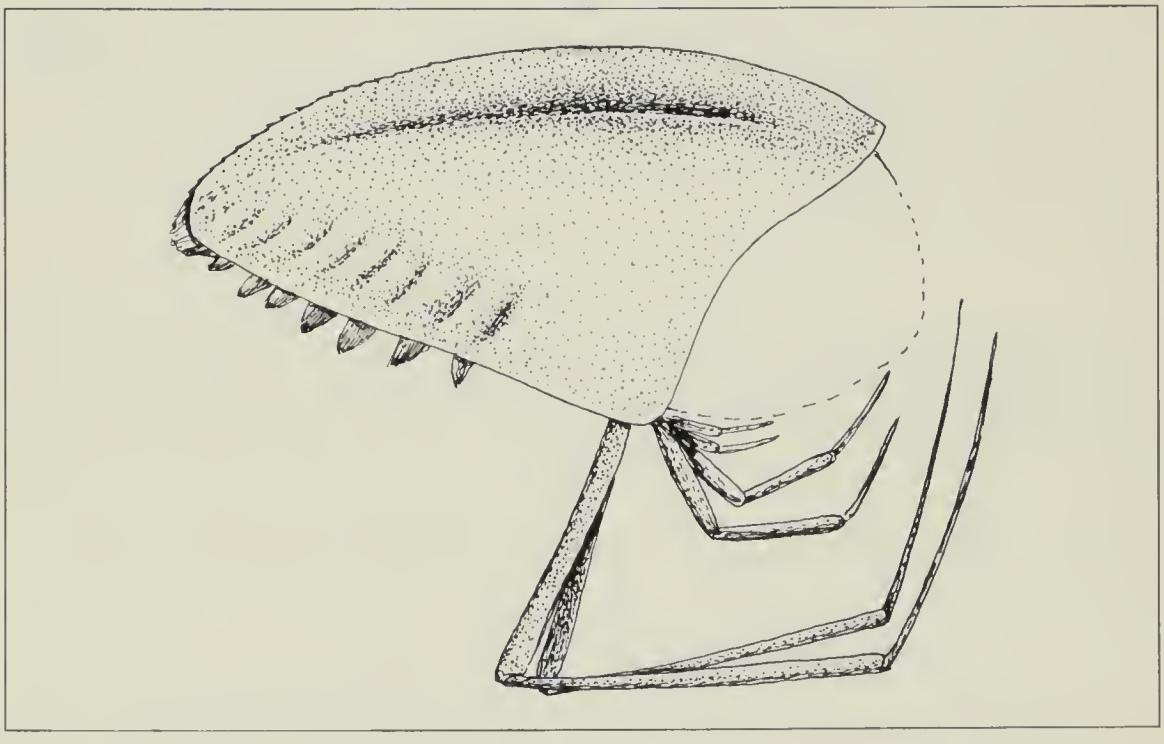

Fig. 2 — *Clausocaris pinnai,* reconstruction by C. Pesarini.

Description

A complete reconstruction of the animal's outer appearance has not been possible, especially as regards the ornamentation, because the cephalic carapace is either missing or poorly preserved. Specimens R.B. 1520, R.B. 1546 and R.B. 1548, where thoracic somites are visible, and specimen R.B. 1520, that still shows part of the cephalic appendages and of the

cephalic sac (in the form of light film), enabled us to reconstruct the anatomy of internal organs and of all appendages.

The univalve carapace has subtrapezoidal, elongated shape; the dorsal margin shows a slight convexity and in its posterior third bears a series of weak triangular denticles directed backwards. The front concave margin features no rostrum in its upper section. The carapace outer surface cannot be observed, but for some scarce fragments, and it shows no ornamentation. There are no prominent carinas crossing the carapace, whereas it is possible to identify the longitudinal muscle. A series of eight thoracic segments are clearly visible; they have preserved their terminations and form a well-developed complex.

There are three pairs of cephalic appendages. From the back we can a first elongated pair, which is distally pointed and thin. In front of this, there is a second, shorter and stronger pair, which in turn is preceded by a third, scarcely developed pair.

Observations

The Norian species differs from the holotypus of the genus *Clausocaris* because of the carapace shape, that in Jurassic specimens is markedly triangular, whereas in Norian specimens is subtrapezoidal. The cephalic margin of *Clausocaris lithographica* is almost straight and nearly as long as the first segment of the third pair of cephalic appendages. In Norian specimens we see a concave front margin, and the length ratios among the segments forming the pair of long appendages at the back are distinctly different from those observed in Jurassic specimens.

Discussion

Here I cannot share the ideas expressed by Polz (1990) in his interpretation of some fundamental structures of the species *Clausocaris lithographica*. In particular, I do not agree with his explanation of the front structure, with his observations on appendage functions, with his observations on the lifestyle of *Clausocaris* and of the Thylacocephala in general.

Polz (fig. 6) represent a structure where he recognizes a large «eye» divided into two lobes, that in the photograph are identified by letters «a» and «b». He explains that the lobe «a» — in which he perceives a hexagonal structure — is situated under the lobe «b», where he observes the presence of structures that he defines as small squamae.

On this basis, Polz affirm that *Clausocaris* had an eye with a regularly hexagonal surface, which lay under another surface bearing evenly distributed squamiform structures. According to Polz, the animal's organ of sight was therefore very efficient, but its line of vision was disturbed by the small squamae lying upon the exagonal surface. To this surface he provisionally attributes a generic defensive function.

Even if I leave aside the functional and adaptative inconsistency of such a structure, the small squamae observed by Polz are very likely to be microsclerites that are situated under the outer surface of the thylacocephala cephalic sac. Probably, in the specimen of *Clausocaris* under observation, the lower lobe shows the inner surface of the hexagonal surface and the upper lobe is nothing but the inner layer featuring micro-

sclerites. As a result, I believe that there is a strong analogy between the structures observed by Polz and those seen in the cephalic sac of *Ostenocaris*. Consequently, my opinion is that I cannot consider the structures observed in *Clausocaris* as belonging to a large eye.

Polz thinks that the three big pairs of appendages in *Clausocaris* represent raptorial organs and he can identify, in the most developed appendage, four distal segments: merus, carpus, propodus and dactylus. The merus has no spines, the carpus and the propodus are equipped with thick setae — which are longer along the inner side — whereas the forked dactylus is characterized by long, subtle spines that project forwards. The two pairs of short legs show very long setae in their inner sides.

According to Polz, raptation occurred in the following way: while the merus was still, carpus, propodus and dactylus — all outstretched — were able to follow an arched trajectory, starting from the bottom and moving upwards until they stopped near the eye.

But, in this case, a prey could be kept only between merus and carpus, i. e. the only segments with a well-developed articulation. However, I think this is not a plausible hypothesis, since the merus has no adequate armour. In addition, if raptation had taken place in the way proposed by this author, I could not explain the presence of well-developed propodus and dactylus which, however, cannot be used by the animal. Moreover, a raptation technique like that suggested by Polz would have been hindered by the presence of the shorther appendages, which were in front of the large raptatorial legs.

The strong spines of the dactylus distal extremity might suggest an analogy with the raptatorial mechanism adopted by some squilloid stomatopods, that impale and so catch their preys. But, in this case, if I consider the extension of the longest limb, its position behind the two short pairs and the ratios between the individual segments forming such limb, I cannot understand how the prey could have been taken to the animal's mouth.

As far as the mouth is concerned, it has not yet been verified whether it is in front or behind cephalic appendages. After examining the stomach residues found in the bolus preserved *in situ* in the cephalic sac of *Ostenocaris,* Alessandrello et al. (1990) have suggested the hypothesis that thylacocephala fed by swallowing animal pieces without any preventive selection; therefore the absence of chewing structures would not be due to the state of preservation of specimens, but to the real lack of these structures. According to the said authors, food was broken up roughly by means of the large appendages.

When I consider the hypothesis of raptatorial predation, it is also necessary to bear in mind that *Clausocaris* and all thylacocephala in general were organisms that had no swimming appendages and were characterized by poor hydrodynamics; moreover, I should not forget the type of stomach residues found in *Ostenocaris*. The only preys, caught by thylacocephala, that so far have been identified with absolute certainty (Pinna et al., 1985), are crustaceans, also including thylacocephalans, small sharks and coleoid cephalopods. The raptation of organisms like live sharks and cephalopods, in particular, requires very efficient predatory organs and considerable mobility.

To support the hypothesis of predation, Polz represents the figure of a specimen of *Clausocaris lithographica* which, in his opinion, was fossilized while preying on a small medusa. If I take into account the fact that most of the fossils preserved in the Lithographic Limestone of Germany are allochthonous «Crustaceans, echinoderms, ray-like sharks and others have been washed into the lagoon by storms» «Most of them died during transport» (Viohl, 1990), it is quite unlikely that this specimen of *C. lithographica* died keeping the prey between its legs; it seems more plausible to believe that this is a purely accidental association.

Therefore I reject the idea, expressed by Rolfe (1985) and by Polz (1990), that thylacocephala were nektonic pelagic animals, which were able to prey on planktonic organisms thanks to their raptorial skills. More likely seems to be the hypothesis assumed by Pinna et al. (1985), according to which thylacocephala were able to adapt themselves to benthic life and to nechrophagous diet.

Particularly interesting is the observation made by Polz on the presence of three pairs of appendages situated just in front of the three pairs of big legs; if such observation could be proved, it would be necessary to reconsider the attribution of the said appendages to tagmata. In their study on thylacocephala, Pinna et al. (1982) ascribed to the cephalon the three large appendages protruding from the lower margin of *Ostenocaris,* to the thorax the eight distinct segments which are almost completely covered by the carapace, and to the abdomen an undefined number of indistinct segments. The presence of another three pairs of appendages in the cephalic region of *Clausocaris,* which is without doubt a thylacocephalan crustacean analogous to *Ostenocaris,* could make one think that the three pairs of main appendages are thoracic and that all the appendages behind them are abdominal. The three front appendages have not been identified in over 1000 specimens observed belonging to the genus *Ostenocaris,* to the genus *Microcaris,* to the genus *Atropicaris* and to the genus *Ankitokazocaris.*

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Bibliography

Alessandrello A., Arduini P., Pinna G. & Teruzzi G., 1990 - New observations on the Thylacocephala (Arthropod, Crustacea). In Simonetta A. M. & Conway Morris S. - The early evolution of Metazoa and the significance of problematic taxa. Proc. Int. Symp. Camerino, *Cambridge Univ. Press,* Cambridge: 245-251.

Arduini P., 1988 - Microcaris and Atropicaris, two genera of the class Thylacocephala. *Atti Soc. Ital. Sci. Nat. Museo Stor. Nat. Milano,* Milano, 129: 159-163.

Arduini P., 1990 - Thylacocephala from Lower Trias of Madagascar. Studies on Permo - Trias of Madagascar n. 1. *Atti Soc. Ital. Sci. Nat. Museo Stor. Nat. Milano,* Milano: 131: 197-204.

Arduini P. & Brasca A., 1984 - Atropicaris, nuovo genere della classe Thylacocephala. *Atti Soc. Ital. Sci. Nat. Museo Stor. Nat. Milano,* Milano, 125: 87-93.

Dalla Vecchia F. M. & Muscio G., 1990 - Occurrence of Thylacocephala (Arthropoda, Crustacea) from the Upper Triassic of Carnic Prealps (N.E. Italy). *Boll. Soc. Pal. It.,* Modena, 29: 39- 42.

Glaessner M. F., 1931 - Eine Crustaceenfauna aus den Lunzer Schichten Niederosterreichs. *Jh. Geol. Bund.,* 81: 476-486.

Mattavelli L. & Rizzini A., 1974 - Facies euxiniche nelle dolomie noriche dell'Ampezzano (Udine): petrografia e sedimentologia. In contributi stratigrafici e paleogeografici sul Mesozoico della Tetide. *Mem. Riv. Ital. Paleont. Strat.,* Milano, 14: 111- 139.

Oppenheim P., 1888 - Neue Crustaceenlarven aus dem lithographischen Schiefer Bayerns. *Z. deutsch. Geol. Ges.,* Berlino, 40: 709-719.

Pinna G., 1974 - I crostacei della fauna triassica di Cene in val Seriana (Bergamo). *Mem. Soc. Ital. Sci. Nat. Museo Stor. Nat. Milano,* Milano, 21:1-50.

Pinna G., Arduini P., Pesarini C. & Teruzzi G., 1982 - Thylacocephala: una nuova classe di Crostacei fossili. *Atti Soc. Ital. Sci. Nat. Museo Stor. Nat. Milano,* Milano, 123: 469-482.

Pinna G., Arduini P., Pesarini C. & Teruzzi G., 1984 - Zamechaniya o nedavno opisannom Klasse rakoobraznykh Thylacocephala i ego sinonim. *Paleontol. J.,* Mosca, 4: 109-113.

Pinna G., Arduini P., Pesarini C. & Teruzzi G., 1985 - Some controversial aspects of the morphology and anatomy of Ostenocaris cypriformis (Crustacea, Thylacocephala). *Trans. R. Soc. Edinburgh: Earth Sci.,* Edimburgo, 76: 373-379.

Polz H., 1988 . Clausia lithographica Oppenheim (?Crustacea). *Archaeopteryx,* Eichstatt, 6: 69-73.

Polz H., 1989 - Clausocaris nom. nov. pro Clausia Oppenheim 1888. *Archaeopteryx,* Eichstatt, 7: 73.

Polz H., 1990 - Clausocaris lithographica (?Crustacea, Thylacocephala). Ein Beitrag zur Morphologie der Thylacocephala. *Archaeopteryx,* Eichstatt, 8: 93-109.

Rolfe W. D. I., 1985 - Form and function in Thylacocephala, Conchyliocarida and Concavicarida (?Crustacea): a problem of interpretation. *Trans. R. Soc. Edinburgh: Earth Sci.,* Edimburgo, 76: 391-399.

Secretan S., 1983 - Une nouvelle classe fossile dans la superclasse des Crustaces: Conchyliocarida. *C. r. Acad. Sci. Paris,* Parigi, 296: 437-439.

Secretan S., 1985 - Conchyliocarida, a class of fossils Crustaceans: relationships to Malacostrata and postulated behaviour. *Trans. R. Soc. Edinburgh: Earth Sci.,* Edimburgo, 76: 381- 389.

Secretan S. & Riou B., 1983 - Un group énigmatique de crustacés: ses représentant du Callovien de La Voulte - sur - Rhône. *Ann. Paleontol.,* Parigi, 69: 59-97.

Schram F. R., 1990 - On Mazon Creek Thylacocephala. *Proc. San Diego Soc. nat. Hist.,* San Diego, 3: 1-16.

Viohl G., 1990 - Solnhofen Lithographic Limestones. In Briggs D.E.G. & Crowther P. R. - Palaeobiology a synthesis, Oxford: 285-289.